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HOUSING FINANCE: IMPACT OF HEAVY INTEREST INCOME TAX

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ABSTRACT

Heavy taxation of interest income becomes a structural driver of property prices in a low-interest-rate environment. Inflation-adjusted price appreciation in 1996-2017 is approximately 200 basis points higher in 14 countries allowing no exemptions on interest income than in 37 countries that tax interest income at favorable rates or provide exemptions. Results for average returns over long-term periods are confirmed in models with annual frequencies, city-level data, and in a sample of 39 OECD countries for which price/rent ratios are available. It appears that investors view direct real estate, a heavily tax-favored asset, as an inflation hedge and/or alternative to fixed income asset. Higher interest income taxation may be fueling demand for direct real estate investments by retail investors. Separately, my empirical findings suggest that easy monetary policy effects can be magnified through the housing channel in countries that do not allow exemptions on interest income. Consequently, we should expect larger investment misallocations due to asset prices departure from fundamentals in some geographies.

Keywords: Housing Market, Direct Real Estate, Price-Rent Ratio, Return, Macroeconomics, Tax, Fixed-Income.

JEL Classification Codes: E3, E4, F3, G1, G5, H2.

INTRODUCTION

The global financial crisis has clearly demonstrated the macroeconomic imbalances the housing market can cause. It is telling that, in the aftermath of the crisis, the IMF established the Global Housing Watch, and the Federal Reserve Bank of Dallas created the International House Price Database. At the same time, rapid price run-up and collapse of house prices in the United States raised questions regarding the rationality of investor behavior in the real estate markets (Fu & Qian, 2014).

In parallel, a growing real estate finance literature attempted to explain variation in price dynamics prior to and after the implosion of the subprime mortgage market in the United States in 2008. Previously, several papers have documented changes in housing demand during the business cycle (Demary, 2010; Inglesi-Lotz & Gupta, 2013). This study examines the differential impact of

interest income taxation on the housing market conditional on the monetary policy regime. It connects several strands of literature.

First, it is related to work on price forecasting (see, among others, Case & Shiller, 1990; Gu, 2002; Shindler, 2013; Gau, 1984; Clayton, 1998). Second, it extends work on market efficiency, which in the real estate literature goes back to at least the mid-1980s (Linneman, 1986; Case & Shiller, 1989; Gatzlaff, 1994; Gatzlaff & Tirtiroglu, 1995). More recently, Ho et al. (2015) have provided analysis of international housing markets and related direct real estate investment risk premiums to macro and country-specific institutional factors. One possible explanation forwarded by this strand of literature is that house price inflation is caused by low expected returns or low-risk premiums (Case & Shiller, 2003; Krainer & Wei, 2004; Campbell et al., 2009), a proposition that is directly tested in this paper.

Third, my study builds on literature on tax policies' impact on housing demand and price dynamics. Most of the publications in the tax area examine the impact of property taxes on the housing market and the economy (see Williamson 1933, for early work). My article is directly related to Poterba et al. (1991), who argue that interest payment deductions could have been one of the drivers of the real estate boom in the 1970s.

In addition, I contribute to the debate on the impact of the macro economy on the real estate sector. Bates et al. (2015) argue that macro effects are more immediate in the short run than specific housing market conditions. In my study, heavy taxation impact is stronger in long-term series, whereas higher frequency data exhibits a higher correlation of returns with interest rates, exchange rate dynamics, immigration, and inertia that characterizes short-term housing prices.

The rest of the article is structured as follows. The next section introduces my empirical methodology, which is followed by a description of the data, discussion of results, and concluding remarks. The appendix describes sources of data for two control variables used in this study.

METHODOLOGY

Previous Literature

This paper builds on a large body of research that examines the relationship between macro variables and housing returns. Heckman (1985) established a link between GDP and real estate returns, and Wheaton et al. (2001) relate housing prices to exogenous factors such as GDP, supply of new stock, and prime lending rate. Ho et al. (2015) document that, in addition to macro variables, country-specific institutional frameworks, including tax incentive structures, affect direct real estate returns. Other studies in this field include Hwang and Quigley (2006), Adams and Füss (2010), Case et al. (2000) and Girouard et al. (2006), Capozza et al. (2002), and Ahuja et al. (2010).

Literature that examines the influence of macroeconomic variables on house prices could be grouped into three broad categories: econometric models, affordability indicators, and asset pricing approach (Girouard et al., 2006; Kishor & Marfatia, 2017). This study falls into the first of the three groups – it employs econometric models to establish fiscal policies' impact on housing prices. Explanatory variables aim to capture demand- and supply-side factors. The determinants from the demand side include real interest rate, population and immigration increases, domestic currency depreciation, changes in household credit, and real GDP per capita growth, while the supply (cost) side is captured by a change in building permits.

Several other measures of economic performance tested in the earlier work-for example, unemployment – are tied together with per capita GDP growth through the cointegrating relationship. Given that my main interest is to establish a long-term relationship between fiscal policies and house prices rather than forecast housing price dynamics, I limit my explanatory variables set to a relatively

short list of predictors. Further, expansion of predictor variables dataset would reduce sample size due to data unavailability outside the most developed markets.

One of the advantages of this study is that it puts to test a variable that is clearly exogenous in the context of employed econometric models. Whereas many macro and real estate sector-specific variables are tied together through feedback mechanisms, tax regimes change only infrequently, allowing to quantify the impact of tax policies on the housing market using relatively simple econometric techniques.

Methodologically, this paper is related to Liu and Mei (1992), who use common stock and bond returns as proxies for two risk factors to explain the performance of publicly traded real estate (REITs) and conclude that the real estate market is integrated with both capital market segments.

Model Specifications

We employ two model specifications in this study to differentiate between permanent and transitory effects - the short-run reaction of house prices to fundamental variables can be different from the long-run response (Adams & Füss, 2010; Kishor & Marfatia, 2017). First, we run an OLS regression with mean changes in inflation-adjusted real estate returns as the dependent variable, heavy tax categorical variable, and a group of control variables:

$$\bar{r} = \alpha_i + \beta_{HT} \times HT + \beta_t \times X_{it} + e_{it}, \quad (1)$$

Where, $\bar{r}$ is a mean inflation-adjusted return on real estate, HT is a heavy tax categorical variable and X_{it} is a vector of country characteristics. Second, we re-visit the results using a panel data set and, annual frequency data:

$$r_i = \alpha_i + \beta_{HT} \times HT + \beta_t \times X_{it} + \beta_{t-1,t-5} \times X_{i,t-1,t-5} + AR(1) + e_{it}, \quad (2)$$

Where, r_i represents an annual inflation-adjusted return on real estate, X_{it} is a vector of static control variables, $X_{i,\,t-1,\,t-5}$ is a vector of five-year averages for dynamic control variables, and AR(1) is a first-order auto-regressive term. My models with annual frequencies closely resemble the forecasting equation employed by Poterba et al. (1991).

We put a heavy tax dummy to test in seven models. All OLS models with means – see tables 5, 7, and 9 – use the same specifications as reported in panel A in table 5, but due to space considerations, I report only heavy tax betas and goodness-of-fit statistics. Likewise, all annual regressions reported in tables 6, 8, and 10 replicate models reported in panel A of Table 6. In each table, heavy tax betas are reported for five datasets – the whole sample and high- and low-interest-rate environment in the United States and domestic markets.

Our research set-up is comparable with Poterba et al. (1991), who examine the interaction of high inflation rates and the U.S. income tax code changes that allowed households to deduct nominal interest payments on the housing market. The use of interaction low-interest-rate/heavy-interest-taxation variable does not alter conclusions reported in this paper, but we prefer to investigate taxation effects separately in high- and low-interest rate periods for clarity of exposition.

In annual regression models, we follow Lowry (2003), who introduced the autoregressive term of order one to account for non-stationarity in annual and quarterly IPO time series. In real estate

finance literature, a similar approach was implemented by Gan (2010). The standard errors are Newey-West heteroskedastic autocorrelation consistent.

High- and Low-interest Rate Regimes Classification

Three areas represented by grey shading in figure 1 correspond to the high U.S. interest rate environment; the remaining two identify low-interest-rate periods. Choice of the U.S. interest rate regime for classification purposes is dictated by the growing integration of global markets and increasing correlation in housing market returns, a development documented in several studies on real estate (Pavlidis et al., 2016; Gomez-Gonzalez et al., 2018; de Bandt et al., 2010) and credit markets (Taylor, 2013). Yet, the weakness of this approach is its subjectivity, so I re-run my tests using a classification based on domestic interest rates.

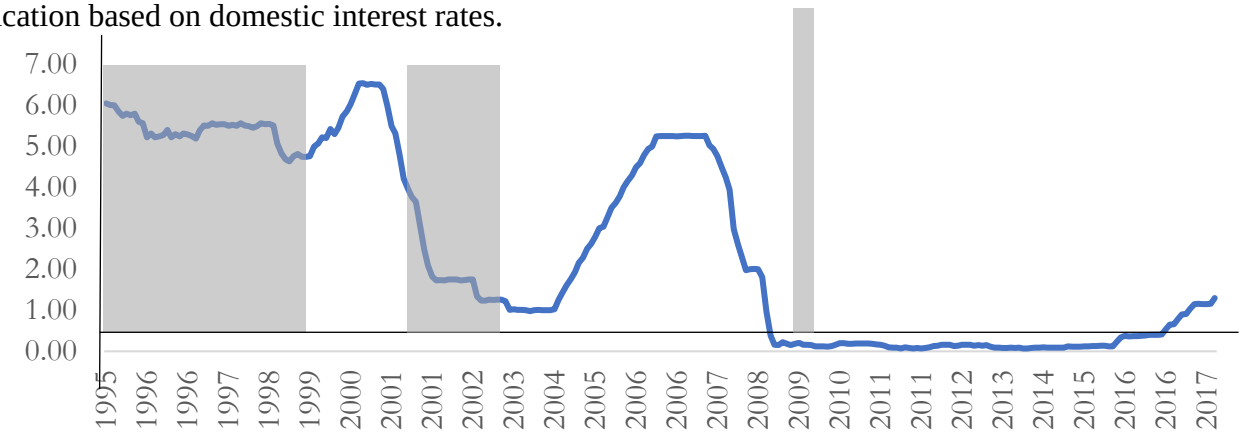

Figure 1. Federal funds rate
Source: Federal Reserve Bank of St. Louis. (2021)

In the domestic markets low-interest-rate periods are identified as calendar years for which after-tax interest rate is below the domestic rate of inflation:

$$\text{low-interest rate year} = 1 \text{ if } R \times (1 - T) < \text{inflation, 0 otherwise} \quad (3)$$

Where, the rate of return on a 10-year government bond or another available interest rate that proxies for domestic risk-free rate (see Appendix A for sourced Datastream series) and T is marginal tax rate from the KPMG list (see data description). In addition to the national level data series, we put my hypothesis to test in a sample of capital cities. This allows for a more nuanced view of the heavy tax impact on housing prices.

DATA

There are several sources of data. National real estate prices are from the Organisation for Economic Co-operation and Development (OECD) housing prices database, and city-level data are from the residential property price series of the Bank of International Settlements (BIS). In addition, national-level data for the Philippines was added from the BIS database, and Teranet and National Bank of Canada data were used to track residential house dynamics in Toronto, Canada. My sample runs from 1996 to 2017. I obtain the real house price index by adjusting the nominal index changes by annual inflation rates.

Classification of income tax regimes is from Horan and Robinson (2008) and is based on information provided in International Business Guides from Deloitte Touche Tohmatsu and

PricewaterhouseCoopers online database of worldwide taxation. Fourteen out of fifty-one nations in my sample tax interest income in full. Table 1 reports geometric returns for fifty-one national markets and twenty-seven capital cities, the number of years for which data are available, and classification by type of interest income taxation.

Data on GDP growth, population changes, and foreign exchange rates were sourced from the World Bank and the International Monetary Fund for Taiwan. Net migration is reported by the World Bank in five-year intervals, so each figure was spread over a five-year period and scaled by starting population level to measure annual migration impact. Appendix A reports sources for interest rates and building permit series from the DataStream database system. The use of a 10-year Treasury bond yield as a measure of nominal long-term discount rate is consistent with Lai and Van Order (2017) and Campbell et al. (2009). Finally, total credit to households for forty-two national markets was obtained from the Bank for International Settlements credit to the non-financial sector (CRE) dataset, and tax rates were extracted from the KPMG individual income tax rates table (KPMG, 2021).

EMPIRICAL ANALYSIS

Real Estate Capital Gains: Preliminary Analysis

Mean inflation-adjusted returns for heavy and light interest tax regimes are reported in table 2. Average real price appreciation equaled 3.45 percent versus 1.79 percent, and most of the gap is due to large price increases during low-interest rate periods in heavy tax geographies (see panels B and C in table 2).

Pairwise comparisons could reflect differences in cross-country characteristics, including institutional and legal frameworks. To isolate these effects, I examine housing price dynamics in five OECD-member countries with a common law legal system – Australia, Canada, New Zealand, the United Kingdom, and the United States, for which data are available for the whole 22-year period (see table 3).

Two patterns emerge. First, prices in heavy tax geographies exhibit stronger downward stickiness – massive price declines in 2008-2009 and 2011 in the United Kingdom and the United States are strikingly different from price dynamics in the other three common law countries. Consequently, over the 1996-2017 period, countries offering tax exemptions recorded a lower return, but much higher volatility. Second, the better performance of heavy tax countries is time dependent; heavy tax countries underperformed the U.K./U.S.A. pair by 1.4 percent in 1996-2006 but outperformed it by 4.1 percent in 2007-2017 with the largest differences accumulated during the bear markets (see table 3).

We proceed to examine pairwise correlations of inflation-adjusted returns, tax variables, and control variables. Pairwise correlations are reported for the whole sample and in high- and low-interest rate subsamples (see table 4). Panel A reports correlations for means and panel B includes estimates for annual data frequencies.

Table 1. Real estate market returns, rankings, and data availability

Country rankings	Country	Geometric return, by country	Years, country	Capital city rankings	Geometric return, capital city	Years, capital	Heavy tax
1	India	8.2%	7	3	7.1%	7	1
2	Malaysia	6.2%	8	2	7.1%	8	0

3	Sweden	5.8%	22	n.a.	n.a.	n.a.	0
4	Taiwan	5.7%	16	n.a.	n.a.	n.a.	1
5	Norway	5.3%	22	4	6.7%	22	1
6	New Zealand	4.9%	22	8	4.6%	22	1
7	Brazil	4.8%	9	10	4.0%	16	0
8	Australia	4.7%	22	13	2.4%	14	1
9	United	4.6%	22	5	6.7%	22	0
10	Canada	4.1%	22	6	4.7%	19	1
11	Ireland	3.8%	22	23	-2.0%	12	0
12	South Africa	3.4%	22	n.a.	n.a.	n.a.	0
13	China	3.4%	7	1	9.1%	6	0
14	Denmark	3.3%	22	n.a.	n.a.	n.a.	1
15	France	3.0%	22	9	4.5%	22	0
16	Turkey	2.9%	7	n.a.	n.a.	n.a.	1
17	Luxembourg	2.9%	10	n.a.	n.a.	n.a.	1
18	Slovakia	2.8%	12	n.a.	n.a.	n.a.	0
19	Belgium	2.8%	22	n.a.	n.a.	n.a.	1
20	Finland	2.78%	22	20	0.5%	7	0
21	Netherlands	2.76%	22	n.a.	n.a.	n.a.	0
22	Russia	2.61%	16	18	1.6%	16	0
23	Hong Kong	2.51%	21	n.a.	n.a.	n.a.	0
24	Philippines	2.36%	2	7	4.6%	9	0
25	Israel	2.25%	22	n.a.	n.a.	n.a.	0
26	Austria	2.07%	17	17	1.7%	22	0
27	Spain	2.00%	22	n.a.	n.a.	n.a.	1
28	Thailand	1.83%	9	15	1.8%	9	0
29	United States	1.83%	22	n.a.	n.a.	n.a.	0
30	Estonia	1.74%	12	n.a.	n.a.	n.a.	0
31	Colombia	1.68%	22	16	1.8%	20	0
32	Iceland	1.58%	12	n.a.	n.a.	n.a.	0
33	Switzerland	1.46%	22	n.a.	n.a.	n.a.	1
34	Czech	0.84%	9	n.a.	n.a.	n.a.	0
35	Chile	0.83%	15	n.a.	n.a.	n.a.	0
36	Mexico	0.76%	12	12	3.1%	12	1
37	Greece	0.18%	20	21	-0.3%	20	0
38	Italy	-0.06%	22	n.a.	n.a.	n.a.	0

39	Germany	-0.07%	22	11	3.8%	13	1
40	Korea, South	-0.17%	22	n.a.	n.a.	n.a.	0
41	Portugal	-0.32%	22	n.a.	n.a.	n.a.	0
42	Hungary	-0.65%	10	14	2.1%	10	0
43	Singapore	-0.87%	21	n.a.	n.a.	n.a.	0
44	Poland	-1.20%	7	22	-1.5%	11	0
45	Lithuania	-1.23%	11	25	-2.8%	11	0
46	Japan	-1.37%	22	19	0.7%	10	0
47	Latvia	-1.73%	11	n.a.	n.a.	n.a.	0
48	Slovenia	-2.16%	10	24	-2.3%	10	0
49	Indonesia	-2.95%	15	26	-2.9%	15	0
50	Kazakhstan	-5.03%	10	n.a.	n.a.	n.a.	0
51	Saudi Arabia	-7.51%	2	27	-4.9%	2	0

Table 2. Means and t-tests

	Heavy tax regime	**Light tax regime**	**Difference**	**T-test statistic**	**P-value**
Panel A. Means comparison for the whole sample					
Return	3.45%	1.79%	1.67%	3.36	<0.001
N	250	574			
Panel B. Means comparison for the low-interest-rate environment in the U.S.A.					
Return	3.11%	0.58%	2.53%	4.00	<0.001
N	150	367			
Panel C. Means comparison for high-interest rate environment in the U.S.A.					
Return	3.97%	3.93%	0.04%	0.05	0.961
N	100	207			
Panel D. Means comparison for the low-interest-rate environment in domestic markets					
Return	3.62%	1.61%	2.01%	2.70	0.007
N	114	221			
Panel E. Means comparison for high-interest rate environment in domestic markets					
Return	3.32%	1.90%	1.42%	2.12	<0.001
N	136	353			

This table reports mean inflation-adjusted real estate returns in heavy and light interest income tax jurisdictions. Panel A-E report results for the whole sample, low and high-interest rate environment in the U.S.A., and low and high-interest rate environment in domestic markets.

Table 3. Returns for common law OECD countries

Year	Low tax	Heavy tax	Difference
1996	0.5%	1.9%	1.4%
1997	4.0%	2.8%	-1.2%
1998	7.0%	0.1%	-6.9%
1999	7.4%	2.9%	-4.6%
2000	9.1%	1.4%	-7.7%
2001	6.3%	3.3%	-3.0%
2002	10.6%	9.8%	-0.8%
2003	10.0%	13.6%	3.7%
2004	8.5%	9.2%	0.7%
2005	6.1%	5.8%	-0.4%
2006	4.0%	6.9%	2.9%
2007	2.7%	8.7%	6.1%
2008	-9.4%	-1.0%	8.4%
2009	-7.8%	-1.9%	5.9%
2010	-0.3%	5.8%	6.1%
2011	-5.8%	-1.1%	4.7%
2012	-0.4%	1.6%	1.9%
2013	3.0%	4.6%	1.6%
2014	4.7%	5.3%	0.5%
2015	5.3%	7.5%	2.2%
2016	5.2%	8.6%	3.5%
2017	3.6%	7.6%	3.9%
Mean	3.4%	4.7%	1.3%
St. dev.	5.4%	4.1%	-1.3%

The table reports annual returns in five OECD countries - Australia, Canada, New Zealand, the U.S.A., and the United Kingdom. Three countries - Australia, Canada, and New Zealand - impose heavy taxes on interest income.

Preliminary analysis using pairwise correlations confirms that heavy tax impact could be regime-dependent (see table 4). In correlations for means (panel A of table 4), heavy tax dummy attains larger value when the U.S. interest rates are low, but not when domestic classification is used. Results in panel B for panel data with annual frequencies are more in line with expectations both for the heavy tax dummy and control variables - correlations are stronger and more significant when interest rates are low in both the U.S. and domestic interest rate classifications.

Table 4. Pairwise correlations

Panel A. Correlations for means					
	Whole sample	**Low U.S. rates**	**High U.S. rates**	**Low home rates**	**High home rates**
	(1)	(2)	(3)	(4)	(5)
Currency depreciation	-0.04	-0.03	-0.30**	-0.25*	-0.28**
Growth GDP per capita	0.30**	0.22	0.65***	0.28*	0.54**
Log GDP per capita	-0.08	-0.15	0.08	0.02	-0.04
Inflation	0.09	-0.01	0.02	-0.10	0.12
Tax rate	0.36***	0.31**	0.00	-0.02	0.43***
Population increase	0.09	0.27**	-0.42***	-0.14	0.40***
Immigration change	0.19	0.27*	-0.13	-0.01	0.31**
Increase in building permits	0.35**	0.54***	0.31**	0.19	0.48***
Interest rate	0.14	0.06	-0.12	-0.20	0.11
After-tax interest rate	0.05	-0.02	-0.11	-0.15	-0.04
Change in credit to households	0.12	-0.10	0.59***	0.17	0.09
Heavy tax	0.34**	0.38**	-0.07	0.13	0.26*
Panel B. Correlations for annual frequencies					
Currency depreciation	-0.18***	-0.18***	-0.19***	-0.17***	-0.18***
Growth GDP per capita	0.43***	0.35***	0.51***	0.37***	0.47***
Log GDP per capita	0.03	-0.00	0.13**	-0.00	0.05
Inflation	-0.10***	-0.18***	0.01	-0.18***	-0.06
Tax rate	0.06*	0.05	0.01	0.02	0.09**
Population increase	0.08**	0.20***	-0.15**	-0.10*	0.20***
Immigration change	0.18***	0.23***	0.05	0.10*	0.22***
Increase in building permits	0.22***	0.24***	0.22***	0.16***	0.27***
Interest rate	-0.14***	-0.17***	-0.17***	-0.09*	-0.17***
After-tax interest rate	-0.15***	-0.17***	-0.18***	-0.07	-0.20***
Change in credit to households	0.22***	0.16***	0.30***	0.33***	0.14***
Heavy tax	0.10**	0.15***	0.00	0.13**	0.08*

*This table reports pairwise correlations of inflation-adjusted returns and various explanatory variables. Panel A reports correlations for means over the whole period, and panel B reports correlations for annual data frequency. Columns 1-5 report results for the whole sample, low and high-interest rate environment in the U.S.A., and low and high-interest rate environment in domestic markets. *,** and *** indicate a p-value of 10%, 5%, and 1%, respectively.*

GDP growth is significant in all samples and change in building permits is positive and significant in all but one. Other control variables attain larger significance in higher frequency data (panel B). Higher interest rates and domestic currency depreciation dampen demand for housing, change in credit to households fuels price increases, whereas immigration and inflation take on expected signs and are significant in most subsamples.

Further, marginal tax rates are positively related to price appreciation over longer periods in the whole sample and two subsamples (panel A in table 4). A positive correlation of marginal tax rates with price increases could be due to the tax-exempt status of the main residence. The effect can be similar for high-tax geographies in the same way interest payment deductions in computing taxable income had a larger impact on high-tax rate households in the United States (Poterba et al., 1991). The marginal tax variable is included in regression models 1 and 7 in tables 4 – 10.

MULTIVARIATE ANALYSIS

Table 5 reports baseline estimates of regression models with means. Heavy interest income taxation is associated with an additional 1.3-2.4 percent increase in inflation-adjusted house prices (see panel A). In a low-rate environment, the magnitude is 1.6-3.5 percent higher depending on the classification used (see results in panels B and D). Interestingly, the marginal tax variable also attains a positive value in panel A, suggesting larger price appreciation in high-tax geographies. However, it does not render heavy tax variables insignificant.

In annual frequencies, heavy tax variable attains a positive sign in models for the whole sample, but it is statistically significant in only some of the regressions in low-interest-rate subsamples (see table 6). Results suggest that heavy tax effects may best be measured over longer intervals.

Further, the momentum effect may be capturing some of the tax impacts in higher frequency data. My estimate of 0.49-0.51 for AR (1) term almost exactly matches Hwang and Quigley (2006), and my goodness-of-fit statistics of 33 percent to 41 percent are slightly higher than their R-squared of 23 percent reported for an autoregressive model with one term and no control variables.

Results in annual regressions lend partial support to the main hypothesis tested in this study. Heavy tax impact on housing prices is regime-dependent; heavy tax betas in panels B and D in table 6 are clearly different from estimates in panels C and E.

Next, we examine whether results can be replicated using data for twenty-seven capital cities, of which seven represent heavy tax geographies. Statistical significance for city-level OLS regressions with means are slightly weaker than for national markets, but heavy tax impact is slightly larger in magnitude than in the national market's sample, and its influence is larger in the low-interest environment in the United States (table 7).

Results in table 7 are weaker for classification based on domestic rates; in fact, heavy tax variable attains marginal significance in two models when domestic rates are high (see panel E). This could be due to momentum behavior – the bull market can be triggered in a low-interest rate regime, but spillover effects may be felt in its aftermath. In city-level models with annual frequencies, heavy tax variable attains significance in all models when the U.S. rates are low except model 5 (panel B table 8). However, lower significance in model 5 is a consequence of a smaller sample size – when building permits and household credit are tested interchangeably, more observations are used, leaving heavy tax variables significant at a ten percent level. Overall, regression models for capital cities have slightly lower explanatory power, but this result could be due to the use of control variables specified at the national level and/or smaller sample size.

Finally, we examine heavy tax impact on changes in price-rent ratio, which corresponds to a price-dividend ratio for stocks and is used as an over-valuation metric in real estate finance literature.

Our sample in tables 9 and 10 are based on data for thirty-nine national markets from the OECD housing prices database. Heavy tax impact varies depending on interest rate regime; the strongest results in OLS regressions with means are observed in the low domestic rates subsample (panel D of table 9). Heavy tax attains significance in five models out of seven and is only marginally insignificant in models with demographic variables, in which it attains a p-value of 0.11 and 0.12, respectively (models 3-4 in panel D of table 9).

Table 5. Regressions with means for national markets

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax	0.017*	0.024**	0.018*	0.021**	0.013**	0.017*	0.018**
	0.008	0.009	0.009	0.009	0.006	0.009	0.008
Tax rate	0.064**						0.073**
	0.030						0.028
Real interest rate		0.32					
		0.21					
FX depreciation		0.06					
		0.14					
Change in credit to households					0.09		
					0.07		
Immigration			0.56			1.39	
			1.11			1.07	
Population increase, net				0.06			
				0.52			
Increase in building permits					0.12***		
					0.04		
Growth GDP per capita						0.69***	0.66***
						0.24	0.22
N. of obs. observations	51	51	50	51	37	50	51
R-square	0.20	0.16	0.10	0.12	0.27	0.24	0.32
Panel B. Low interest rate environment in the U.S.A.							
Heavy tax	0.025**	0.035**	0.023*	0.026**	0.016**	0.022*	0.026**
	0.011	0.011	0.012	0.011	0.006	0.012	0.010
Tax rate	0.063*						0.085**
	0.037						0.036
R-square	0.19	0.18	0.14	0.18	0.52	0.22	0.29

Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	-0.010	-0.001	-0.005	-0.000	-0.001	0.001	0.002
	0.019	0.018	0.019	0.016	0.012	0.015	0.014
Tax rate	0.011						0.049
	0.064						0.049
R-square	0.01	0.10	0.02	0.17	0.44	0.44	0.44
Panel D. Low interest rate environment, domestic							
Heavy tax	0.019*	0.020*	0.020	0.021*	0.019*	0.021*	0.023**
	0.011	0.010	0.013	0.011	0.010	0.012	0.011
Tax rate	-0.022						0.027
	0.044						0.046
R-square	0.06	0.16	0.05	0.10	0.22	0.16	0.18
Panel E. High interest rate environment, domestic							
Heavy tax	0.012	0.022	0.012	0.018	0.007	0.006	0.011
	0.013	0.013	0.014	0.012	0.011	0.012	0.011
Tax rate	0.120**						0.090**
	0.043						0.038
R-square	0.21	0.14	0.11	0.20	0.17	0.41	0.42

*This table reports OLS regression model results with means and inflation-adjusted return as a dependent variable for 51 national markets. Panel A reports results for the whole sample, and panels B-D report heavy tax betas and R-squared for different monetary policy regimes. *,** and *** indicate a p-value of 10%, 5%, and 1%, respectively.*

Table 6. Regressions with annual data frequency for national markets

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax (t)	0.006	0.005	0.003	0.006	0.009*	0.004	0.007*
	0.004	0.004	0.005	0.005	0.005	0.005	0.004
Tax rate (t)	-0.010						-0.010
	0.025						0.022
Real interest rate (t)		-0.05					
		0.11					
FX depreciation (t)		-0.10***					
		0.02					
Change in credit to households (t-1;t-5)					0.07		
					0.12		

Immigration (t-1; t-5)			0.73			0.78	
			0.73			0.72	
Population increase (t-1; t-5)				-0.41			
				0.31			
Increase in building permits (t-1; t-5)					0.08**		
					0.04		
Growth, GDP per capita (t-1;t-5)						0.38**	0.34***
						0.15	0.15
Lag (1)	0.50***	0.49***	0.55***	0.55***	0.51***	0.51***	0.52***
	0.07	0.07	0.06	0.06	0.08	0.06	0.05
N. of observations	715	709	582	595	426	582	595
R-square	0.31	0.33	0.39	0.40	0.41	0.40	0.41
Panel B. Low interest rate environment in the U.S.A.							
Heavy tax	0.010*	0.008	0.007	0.010*	0.012**	0.008	0.010*
	0.005	0.005	0.006	0.005	0.006	0.006	0.005
Tax rate (t)	-0.019						-0.006
	0.026						0.027
	0.026						0.027
R-square	0.36	0.38	0.36	0.36	0.41	0.36	0.36
Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	-0.000	0.001	-0.006	-0.001	0.003	0.000	0.006
	0.005	0.007	0.010	0.008	0.010	0.009	0.006
Tax rate (t)	0.003						-0.038
	0.059						0.051
R-square	0.25	0.27	0.44	0.43	0.50	0.48	0.47
Panel D. Low interest rate environment, domestic							
Heavy tax	0.011**	0.013**	0.006	0.012*	0.019**	0.007	0.011**
	0.005	0.006	0.007	0.006	0.007	0.006	0.005
Tax rate (t)	-0.006						0.011
	0.038						0.031
R-square	0.33	0.35	0.32	0.32	0.37	0.32	0.32
Panel E. High interest rate environment, domestic							
Heavy tax	0.002	-0.002	-0.000	-0.001	0.005	0.001	0.004

	0.005	0.006	0.007	0.006	0.007	0.007	0.006
Tax rate (t)	-0.002						0.037
	0.035						0.033
R-square	0.30	0.33	0.46	0.46	0.49	0.49	0.49

*This table reports model results with annual data frequency and Newey-West corrected errors for 51 national markets. Control variables are contemporaneous or average of previous five years. Panel A reports results for the whole sample, panels B-D report heavy tax betas and R-squared for different monetary policy regimes. *,**,*** indicate a p-value of 10%, 5%, and 1%, respectively.*

Table 7. Heavy tax betas in regressions with means for capital cities

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax (t)	0.027*	0.032*	0.025	0.028*	0.019	0.016	0.028*
R-square	0.18	0.17	0.15	0.14	0.23	0.37	0.34
Panel B. Low-interest rate environment in the U.S.A.							
Heavy tax	0.038*	0.040*	0.035	0.038*	0.015	0.027	0.043**
R-square	0.25	0.16	0.17	0.18	0.51	0.42	0.45
Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	-0.009	-0.010	-0.014	-0.004	0.001	-0.020	-0.008
R-square	0.05	0.17	0.01	0.14	0.27	0.25	0.24
Panel D. Low-interest rate environment, domestic							
Heavy tax	0.022	0.022	0.025	0.024	0.017	0.027	0.034
R-square	0.04	0.10	0.04	0.04	0.46	0.09	0.11
Panel E. High-interest rate environment, domestic							
Heavy tax	0.025	0.027	0.016	0.025	0.024	-0.010	0.019
R-square	0.18	0.12	0.16	0.16	0.28	0.45	0.31

*This table reports selected OLS regression model results with means and inflation-adjusted return as the dependent variable for 27 capital cities. Panel A-E reports heavy tax betas and R-squared for the whole sample and for different monetary policy regimes. *,**, and *** indicate a p-value of 10%, 5%, and 1%, respectively.*

Table 8. Heavy tax betas in regressions with annual data frequency for capital cities

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax (t)	0.013*	0.013	0.011	0.014*	0.013	0.011	0.013*
R-square	0.22	0.22	0.22	0.22	0.17	0.22	0.22
Panel B. Low-interest rate environment in the U.S.A.							

Heavy tax	0.021**	0.021**	0.021*	0.020**	0.013	0.021*	0.021**
R-square	0.22	0.22	0.21	0.21	0.27	0.22	0.22
Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	-0.003	-0.005	-0.005	0.055	-0.013	-0.004	-0.001
R-square	0.23	0.23	0.22	0.26	0.40	0.27	0.28
Panel D. Low-interest rate environment, domestic							
Heavy tax	0.017	0.019	0.018	0.025*	0.027	0.017	0.017
R-square	0.11	0.11	0.11	0.12	0.10	0.11	0.11
Panel E. High-interest rate environment, domestic							
Heavy tax	0.013	0.007	0.005	0.012	0.008	0.004	0.013
R-square	0.32	0.34	0.32	0.32	0.37	0.32	0.32

*This table reports selected model results with annual data frequency and Newey-West corrected errors for 27 capital cities. Control variables are contemporaneous or average of previous five years. Panel A-E reports heavy tax betas and R-squared for the whole sample and for different monetary policy regimes. *,**,*** indicate a p-value of 10%, 5%, and 1%, respectively.*

Results are much stronger for the Newey-West regressions with annual frequencies reported in table 10. The heavy tax dummy is significant in all models in panel D and is significant in all but one model in panel A. Even then, in model 3 of panel A, it's only marginally insignificant with a p-value of 0.114.

A certain pattern emerges in annual frequency regressions. Heavy tax impact on national house prices is felt when domestic interest rates are low (see tables 6 and 10). In city-level annual data, influence is observed when the U.S. embarks on easy monetary policy (table 8). The difference could be due to the arrival of immigrant cohorts, which may have larger exposure to international rather than domestic rates. This is indirectly confirmed by the weaker statistical of significance of heavy tax variables in regression models with demographic controls.

Table 9**.** Heavy tax betas in regressions with means for price/rent ratio.

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax (t)	0.018**	0.029***	0.011	0.010	0.017	0.012	0.018**
R-square	0.32	0.26	0.23	0.42	0.33	0.24	0.32
Panel B. Low-interest rate environment in the U.S.A.							
Heavy tax	0.025**	0.029**	0.011	0.007	0.018**	0.011	0.025**
R-square	0.32	0.23	0.33	0.64	0.37	0.33	0.33
Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	-0.003	0.000	0.002	-0.004	0.006	0.003	-0.002
R-square	0.01	0.03	0.03	0.00	0.12	0.03	0.02

Panel D. Low-interest rate environment, domestic							
Heavy tax	0.024*	0.028**	0.026	0.022	0.021*	0.026*	0.023*
R-square	0.15	0.13	0.12	0.14	0.36	0.15	0.16
Panel E. High-interest rate environment, domestic							
Heavy tax	0.002	0.015	-0.019	-0.005	-0.001	-0.017	-0.001
R-square	0.16	0.23	0.22	0.39	0.12	0.35	0.32

*This table reports OLS regression model results with means and nationwide price/rent ratio change as the dependent variable for 39 OECD countries. Panel A-E reports heavy tax betas and R-squared for the whole sample and for different monetary policy regimes. *,**, and *** indicate a p-value of 10%, 5%, and 1%, respectively.*

Control variables are suppressed in all tables, except panel A in tables 5 and 6 due to space considerations (they are available upon request). One can indirectly gauge the impact of dependent variables by comparing goodness-of-fit statistics. For example, in panel A of table 5, R-squared is larger in models 5-7, which include building permits and GDP growth.

Table 10**.** Heavy tax betas in regressions with annual data frequency for price/rent ratio

Panel A. Whole sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Heavy tax (t)	0.008*	0.009*	0.010	0.013**	0.011**	0.011*	0.013***
R-square	0.30	0.31	0.29	0.29	0.44	0.30	0.30
Panel B. Low-interest rate environment in the U.S.A.							
Heavy tax	0.010*	0.012*	0.005	0.011	0.012**	0.005	0.012*
R-square	0.36	0.25	0.25	0.24	0.41	0.27	0.26
Panel C. High-interest rate environment in the U.S.A.							
Heavy tax	0.004	0.005	0.023**	0.017**	0.007	0.022**	0.014**
R-square	0.35	0.36	0.39	0.38	0.50	0.40	0.38
Panel D. Low interest rate environment, domestic							
Heavy tax	0.024***	0.026***	0.018**	0.023**	0.018***	0.018**	0.020***
R-square	0.25	0.27	0.25	0.25	0.47	0.25	0.26
Panel E. High-interest rate environment, domestic							
Heavy tax	-0.001	-0.003	0.004	0.007	0.007	0.004	0.008
R-square	0.35	0.36	0.33	0.32	0.45	0.36	0.35

*This table reports selected model results for models with nationwide price/rent ratio change as the dependent variable with annual data frequency and Newey-West corrected errors for 39 OECD countries. Control variables are contemporaneous or average of previous five years. Panel A reports heavy tax betas and R-squared for the whole sample, panels B-D report the same output for different monetary policy regimes. *,**,*** indicate a p-value of 10%, 5%, and 1%, respectively.*

GDP growth and building permits are significant in all specifications, foreign exchange variable attains significance in models with annual frequencies, and immigration is significant in some models. The presence of a statistically significant relationship between inflation-adjusted house prices and economic activity chimes with Kishor and Marfatia (2017) and validates my model specifications.

Further, my estimates of economic growth influence, which range from 0.4 in Newey-West models with annual frequencies to 0.7 in OLS regressions with means, are in line with Adams and Füss (2010), who report that 1 percent increase in economic activity raises demand and house prices over 0.6 percent in the long run in a sample of 15 OECD countries in 1975-2007.

An increase in building permits is positively related to housing price increases in all regression models. Economic theory suggests that long-term relationships should be of opposite nature – Case (2008) observes that, in the U.S. market, the housing cycle peaked four times in 1972, 1978, 1984, and 2006 every time housing starts rose above 2 million on an annualized basis. However, my estimates are in line with previously reported results – Hwang and Quigley (2006) report a positive coefficient on housing supply for single homes in 74 U.S. metropolitan areas in 1987-1999. Separately, Case and Shiller (2003) argue that housing starts may proxy for supply restrictions.

In a similar vein, population growth should have a positive association with demand for real estate, but I do not document such a relationship in my tests. However, Myers and Pitkin (2009) and Mankiw and Weil (1989) suggest that it is not population growth per se that impacts real estate prices, but changes in age structure and arrival of age cohorts in the household formation stage.

It is less surprising that real interest rate appears unrelated to housing prices - interest rates are negatively related to housing prices in pairwise correlations for annual data series (panel B of table 4), but the relationship is not strong enough to survive in multivariate models. My results do not contradict existing literature - Kishor and Marfatia (2017) find a positive relationship between real interest rates and house price dynamics in five out of fifteen OECD markets, and Kuttner (2012) shows that the effect of interest rates on house prices is relatively modest.

Many of the control variables in this study exhibit the same pattern of behavior as in Arrazola et al. (2015), who documented high demand sensitivity to the labor market situation and, to a lesser extent, to demographic changes, but the much smaller impact of real interest rate in the long run in the Spanish housing market in 1975-2009.

Robustness checks in this study included the use of fixed-year effects and one-period lags in models with annual frequencies. Their impact on my results was limited. Outliers diagnosis using DFFITS statistic failed to identify influent observations, and size-adjusted cutoff suggested by Belsley et al. (1980) picked out at most two observations in my regression models. Their elimination lowered the p-value on heavy tax variables, but only marginally (results available upon request).

CONCLUDING REMARKS

Several studies have previously documented international transmission of real estate market bubbles prior to the housing crash in 2008-2009 (in't Veld et al., 2014; Gomez-Gonzalez et al., 2018). Yet, in its aftermath, international real estate markets diverged.

This paper tested the impact of a heavy tax on interest income in both long-term series and higher frequency data. It showed that housing price increases were larger in countries with heavy interest income taxation. I do not suggest a central role of interest income taxation for predictable changes in housing prices. Several variables – economic growth, building permits, and autoregressive term that captures momentum effect – have a larger explanatory power in tested models than my heavy interest income tax variable.

It is possible that heavy tax acts as a trigger in a low-interest-rate environment, but its ripple effects manifest over longer periods due to inertia. This would explain continuing outperformance of real estate markets in several heavy tax common law countries against the backdrop of rising interest rates at the tail end of my sample.

It is an established fact in the economics literature that easy monetary policies impact aggregate demand differently depending on the fiscal policy stance (Freedman et al., 2009). Given the positive relationship between housing wealth and consumption growth (Gan, 2010), easy monetary policy effects can be magnified through the housing channel in countries that do not allow exemptions on interest income. Consequently, we should expect larger investment misallocations due to asset prices departure from fundamentals in some geographies.

Understanding whether the macroeconomy or specific housing market conditions drive prices is crucially important for public policy initiatives. A case-in-point is a fiscal stance in Canada, which historically adjusted its monetary policies in lockstep with the United States, its largest trading partner, and competitor. However, if different interest income taxation regime induces higher price inflation in the residential sector in Canada, easy monetary policies may stimulate corporate sector and consumption directly and in addition promote excessive house price inflation, creating wealth effect and a further increase in consumption.

In addition to policymakers, my results could be of interest to the investment community. Real estate could be viewed by investors as an inflation hedge and/or alternative to the fixed income asset class in a low-interest environment due to expected appreciation on par with inflation. When interest rates drop, households in heavy tax geographies may be replacing fixed income allocation with additional exposure to the real estate asset class. This effect can be mitigated by an increased allowance for tax-free savings accounts (TFSAs), but these have been introduced quite recently – Canada mandated TFSAs in 2009, and the first contribution was capped at a meager $5,000, hardly enough to absorb large allocations to the fixed income asset class.

Interestingly, in the wake of the real estate boom, Canadian public debate shifted to foreign ownership of the real estate in gateway cities – Vancouver and Toronto, but no concerns have been raised about national tax policies which may be partially responsible for the domestic real estate boom (Deschamps, 2018).

Finally, my results are relevant for discussions within the academic community. My findings support the market efficiency hypothesis in the housing markets by identifying an additional factor that explains higher direct real estate returns in geographies without tax exemptions on interest income.

One of the shortcomings of this study is that it does not test several predictor variables that have been shown to impact housing prices in earlier literature, including credit spreads, survey measures, personal savings rates, and consumer confidence (Bork & Müller, 2018). The reason is data scarcity for international markets. However, this gap will eventually be filled in with the growing disclosure of economic data and its dissemination through online channels. I invite further research in this area.

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APPENDICES

Appendix A. Sources of data for interest rates and building permits.

Country Name	Building Permits	Interest Rate Series
Australia	AUYODI15G	TRAU10Y
Austria	OEESK1HFE	TROE10T
Belgium	BGESK1HFG	TRBG10T
Brazil	n.a.	BRSELIC prior to 2006; TRBR10T starting
Canada	CNYODI15Q	TRCN10T
Chile	CLYOD008Q	TRCL10T
China	CHINVHR%A	CHSRW5Y before 2002; TRCH10T starting
Colombia	CBYODI15G	CBBCBPR before 2002; TRCO10T starting
Czech Republic	CZYODI15H	CZBCBPR prior to 2000; TRCZ10T starting
Denmark	DKYODI15Q	TRDK10T
Estonia	EOYODI15P	EOIBK1Y in 1999-2011; EOQIR076R
Finland	FNYODI15H	TRFN10T
France	FRYODI15G	TRFR10T
Germany	BDYODI15G	TRBD10T
Greece	GRYODI15H	TRGR10T
Hong Kong	HKBLCPRNP	TRHK10T
Hungary	HNYODI15G	HNBBASE prior to 1999; TRHN10T starting
Iceland	ICHOUSCN	ICBCBPR prior to 2003; TRIS10T starting
India	n.a.	TRIN10T
Indonesia	n.a.	IDYIR076R in 1998-2002; TRID10T starting
Ireland	IRYODI15Q	TRIE10T
Israel	ISYODI15H	ISMIR080R
Italy	ITESUM8SF	TRIT10T
Japan	JPYWSI41Q	TRJP10T
Kazakhstan	KZCONRESA	KZGBOND.
Korea, South	KOYOD008Q	KOQIR063R prior to 2000; KOOIR080R
Latvia	LVYODI15H	LVYIR076R in 1998-1999; LVGBD5Y starting
Lithuania	LNQODI15H	LNRPAON prior to 2003; LNGBOND starting
Luxembourg	LXYODI15G	LXBENCH
Malaysia	n.a.	MYGBOND.
Mexico	MXGD8FCRA	MXYIR066R prior to 2002; MXYIR080R
Netherlands	NLESK1HFE	NLGBOND.
New Zealand	NZYODI15G	NZYIR080R

Norway	NWYODI15G	NWGBOND.
Philippines	n.a.	PHGBOND.
Poland	POYODI15H	TRPO1YT prior to 1999; POGBOND. starting
Portugal	PTYODI15H	TRPT10T
Russia	RSCONBRN	TRRS6MT prior to 1999; RSQIR080R starting
Saudi Arabia	n.a.	ICSAR10
Singapore	SPPRSUPIP	TRSG10T
Slovakia	SXOAJ32XA	SXOIR080R
Slovenia	SJYODI15P	SJESSFUB after 2002; SJTBL3M in 1998-2002
South Africa	SAYODI15O	TRSA10T
Spain	ESYODI15H	TRES10T
Sweden	SDYODI15H	TRSD10T
Switzerland	SWAOD008Q	TRSW10T
Taiwan	TWBPNUHHP	TRTW10T
Thailand	THCONRESP	THGBOND.
Turkey	TKYODI15G	THGBOND.
United Kingdom	UKAOD008Q	TRUK10T
United States	USBCIPEHO	TRUS10T
The appendix reports Datastream series names for interest rates and building permits. Interest rates are measured – in descending order – using yields on 10-year government bonds, instruments with shorter maturities or bank regulators' re-financing rate.		